

PATENT

Docket S-96306

COMPLETE LISTING OF CLAIMS, INCORPORATING AMENDMENTS
IN RESPONSE TO OFFICE ACTION DATED 3/9/2004
FOR SERIAL NO. 09/759,781

Claims 1-17 (withdrawn)

Claim 18. (original) A method of extracting and sequestering CO₂ from a gas stream, said method comprising the steps of:

hydrating said CO₂ in said gas stream with an aqueous solution to form carbonic acid, thereby resulting in a CO₂-depleted gas stream;

reacting said carbonic acid with carbonate to form a waste stream solution of metal ions and bicarbonate, wherein said carbonate is of the form X(CO₃)_m wherein X is any element or combination of elements that can chemically bond with a carbonate group or its multiple, wherein at least one said element is a group IA, IIA, IIIA, IVA, IB, IIB, IIIB, IVB, VB, VIB, VIIB, or VIIIB element of the periodic table, and wherein m is a stoichiometrically determined positive integer;

pre-treating said waste stream solution to reduce the amount of CO₂ outgassing and carbonate precipitation that may occur after said waste stream solution is released into a disposal site; and

releasing said pre-treated waste stream solution into said disposal site.

Claim 19. (original) The method as recited in claim 18 wherein:

said pre-treating step comprises a CO₂ degassing step selected from the group consisting of allowing said waste stream solution to degas CO₂ to an overlying headspace whose pCO₂ is less than that of said waste stream solution; purging said waste stream with a gas stream whose pCO₂ is less than that of the waste stream; and applying a partial vacuum to the headspace above the waste stream.

Claim 20. (currently amended) The ~~apparatus~~ method as recited in claim 18 wherein:

said pre-treating step comprises diluting said waste stream solution with a second solution that is undersaturated with respect to CO₂, carbonate ions, or both CO₂ and carbonate ions.

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- Claim 21. (currently amended) The ~~apparatus~~ method as recited in claim 18 wherein:
said pre-treating step comprises adding chemical additives which impede carbonate precipitation, said chemical additives being selected from the group consisting of phosphate, metals, and organic compounds, said organic compounds being selected from the group consisting of EDTA, humic substances, aromatic acids, citrate, malate, pyruvate, glycelglycerine, glycogen, arginine, glutamate, glycine, glycoprotein succinate, taurine, chondroitin sulfate, galactose, dextrose and acetate.
- Claim 22. (original) The method as recited in claim 18 wherein:
said pre-treating step comprises exchanging at least a portion of the Ca^{2+} cations present in said waste solution with exchange cations which when balanced by the CO_3^{2-} anions exhibit greater solubility and less propensity for precipitation than does CaCO_3 .
- Claim 23. (original) The method as recited in claim 22 wherein:
said cation exchanging step comprises passing said waste stream solution through an ion exchange column, with said column containing Na^+ exchange ions.
- Claim 24. (currently amended) The ~~apparatus~~ method as recited in claim 18 wherein:
said pre-treating step comprises exchanging at least a portion of the CO_3^{2-} anions present in said waste solution with other anions.
- Claim 25. (currently amended) The ~~apparatus~~ method as recited in claim 24 wherein:
said anion exchanging step comprises passing said waste solution through an ion exchange column containing Cl^- anions.
- Claim 26. (original) The method as recited in claim 18 wherein:
said pre-treating step comprises increasing the density of said waste stream solution.
- Claim 27. (currently amended) The method as recited in claim 18 wherein:

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said disposal site comprises a large body of water that is either freshwater or seawater.

Claim 28. (original) The method as recited in claim 27 wherein:

the $p\text{CO}_2$ of said body of water at the point of release of waste stream solution is less than that of said waste stream solution.

Claim 29. (original) The method as recited in claim 27 wherein:

said releasing step comprises releasing said waste stream solution at a depth sufficient for mixing of said waste stream solution with said body of water to occur.

Claim 30. (original) The method as recited in claim 27 wherein:

said releasing step comprises releasing said waste stream solution at a depth wherein the pressure and temperature existent at said depth is sufficient to impede CO_2 outgassing to the atmosphere and carbonate precipitation.

Claim 31. (original) The method as recited in claim 27 wherein:

said large body of water is either a sea or ocean; and
said releasing step comprises releasing said waste stream solution below the pycnocline.

Claim 32. (original) The method as recited in claim 27 wherein:

said large body of water is either a sea or ocean; and
said releasing step comprises releasing said waste stream solution in the vicinity of a reef, above the pycnocline.

Claim 33. (original) The method as recited in claim 27 wherein:

said disposal site is a body of surface seawater having sufficient constituents that serve to impede carbonate precipitation, said constituents being phosphate, Mg^{2+} ions, or phosphate and Mg^{2+} ions.

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Claim 34. (original) The method as recited in claim 27 wherein:

said disposal site is a body of surface seawater having sufficient organic compounds that serve to impede carbonate precipitation, said organic compounds selected from the group consisting of humic substances, aromatic acids, citrate, malate, pyruvate, glycelglycerine, glycogen, arginine, glutamate, glycine, glycoprotein succinate, taurine, chondroitin sulfate, galactose, dextrose and acetate.

Claim 35 (new) The method as recited in claim 27 wherein:

said large body of water is either a sea or ocean; and
said releasing step comprises releasing said waste stream solution at a depth below the carbonate compensation depth (CCD).